Space Weather Platforms and Future Capabilities

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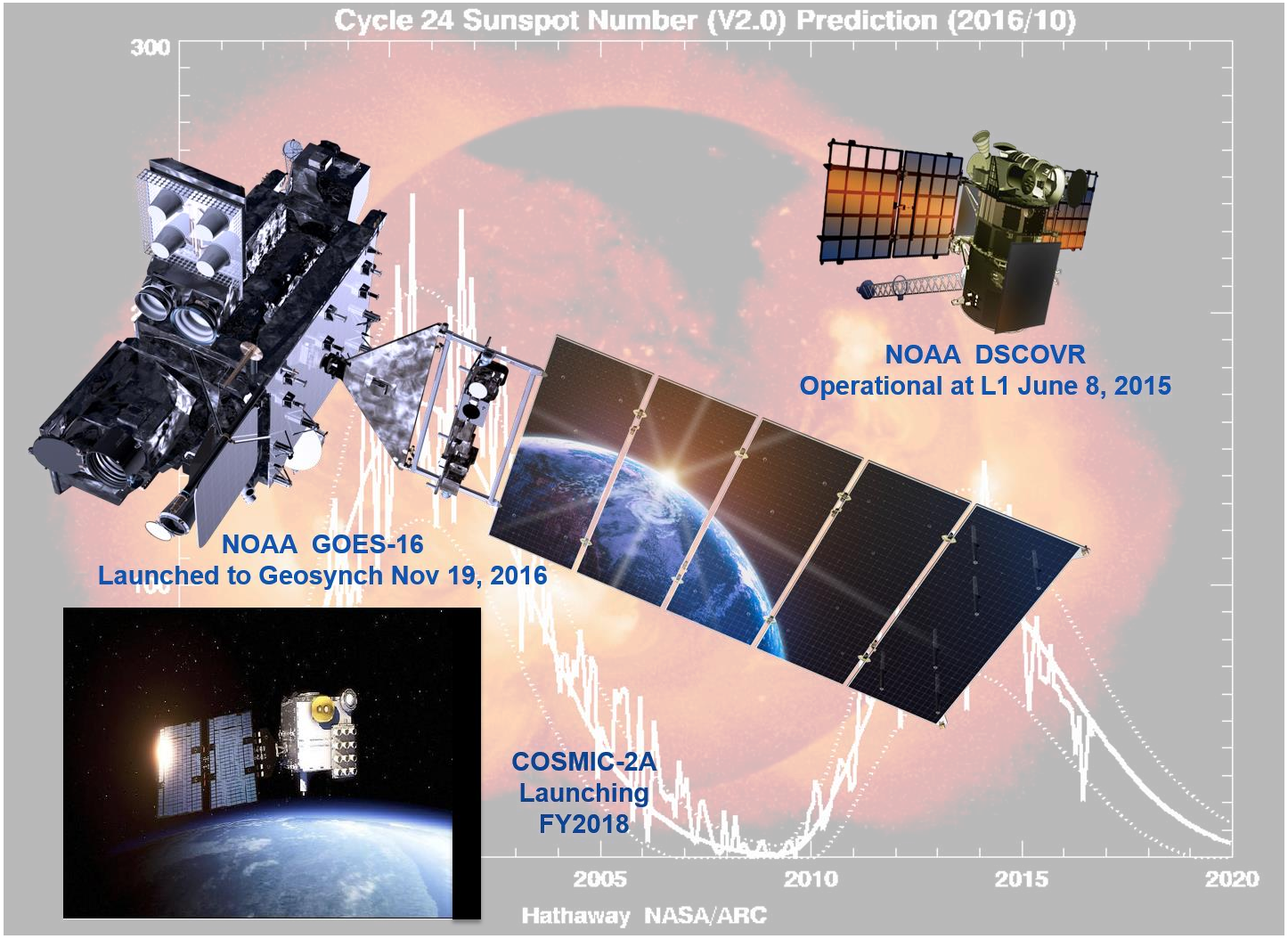
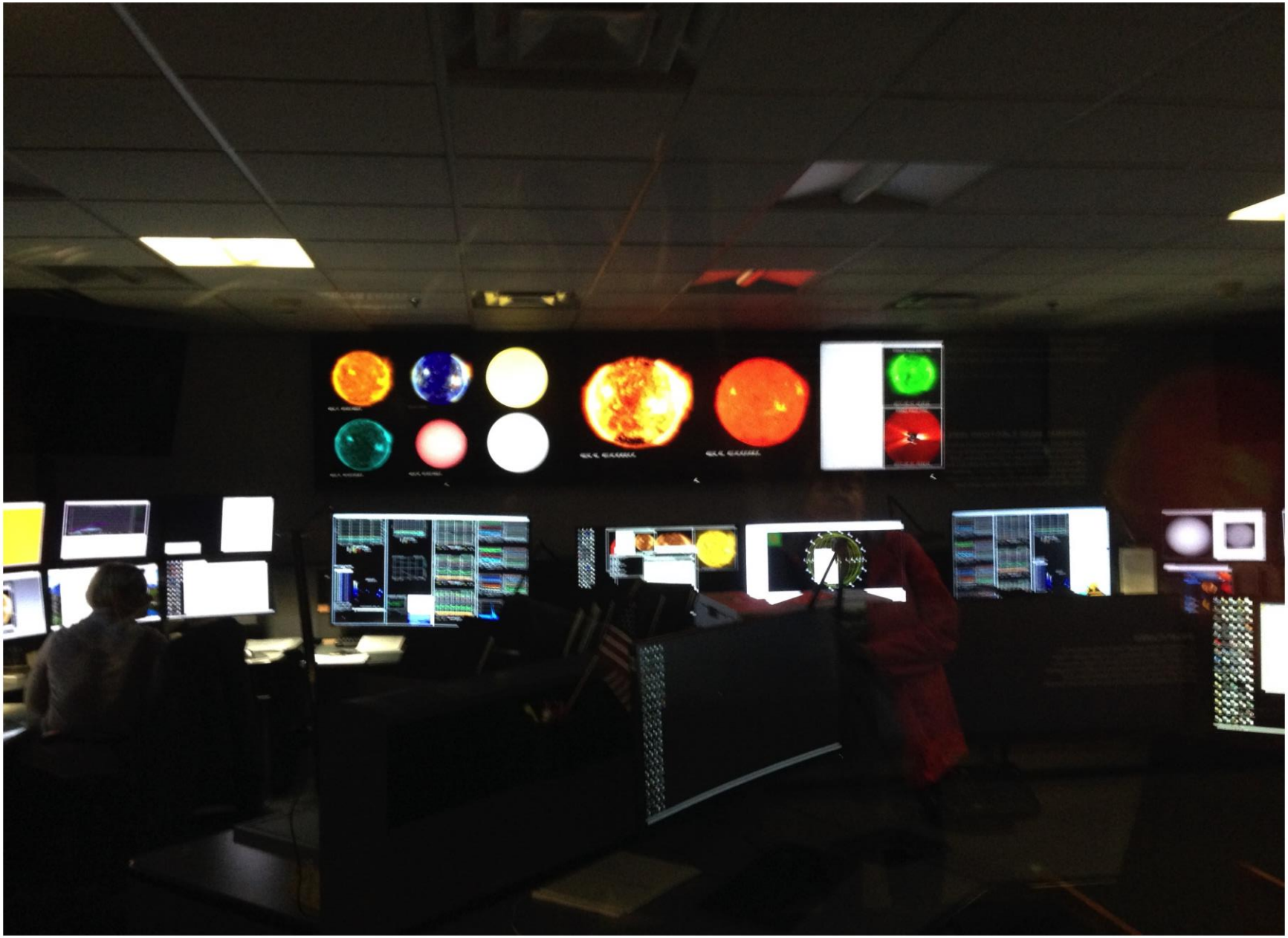
2017 Space Weather Workshop

New Observations

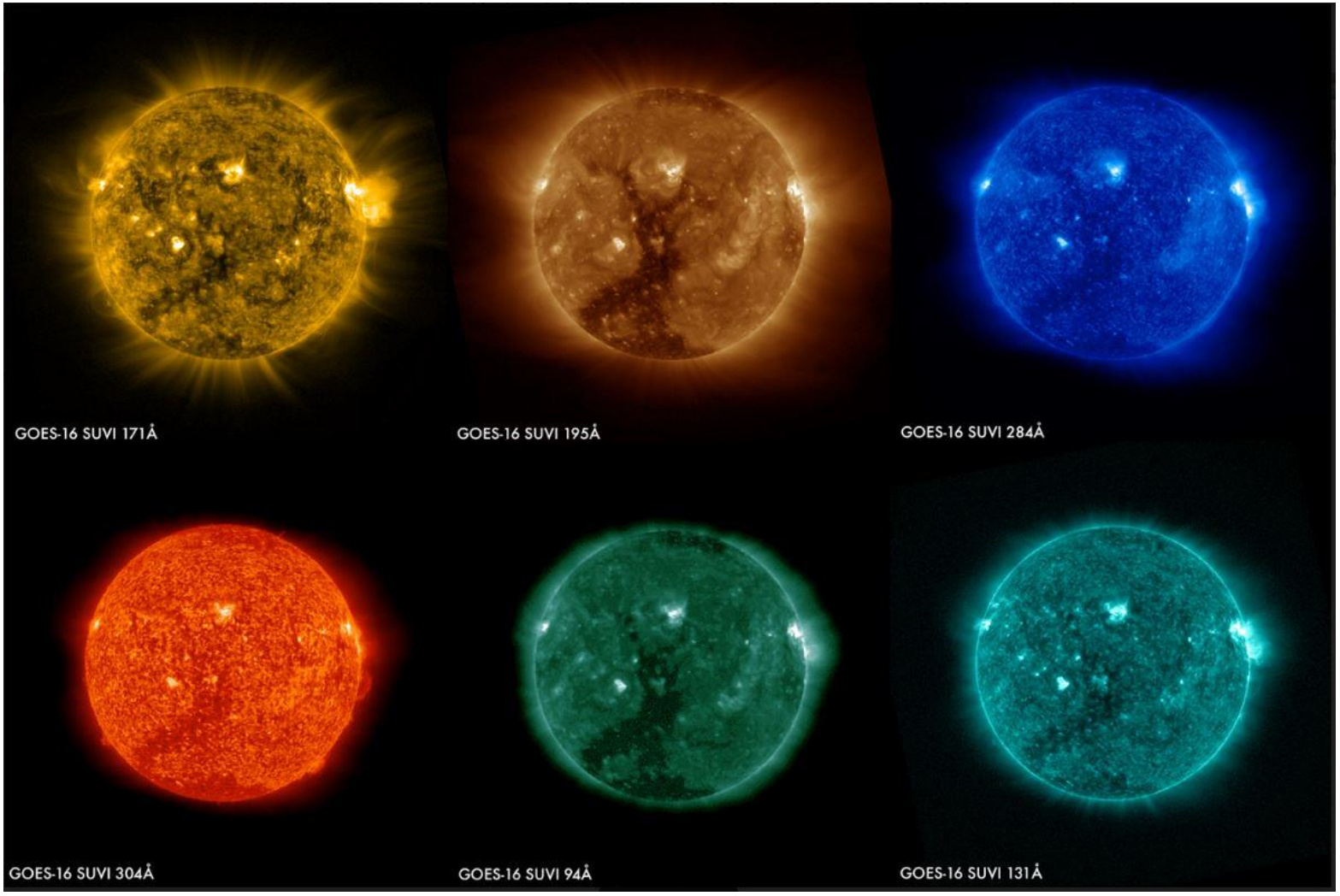




NOAA/NEDIS Space Weather Platforms

- **GOES-16: Continuing the 43 yr record of solar observations from GEO. GOES-R Series to continue with 4 satellites well into 2030s**
  - **Solar disk images from X-ray to EUV wavelengths**
  - **Flare location: quad diode provides fast identification of flare location**
  - **Broader spectral coverage with higher spectral resolution for more accurate inputs into atmosphere/ionosphere models Particle Sensor**
  - **High energy particles with expanded energy range for improved analysis of spacecraft surface charging and to diagnose satellite internal charging**
  - **Solar protons for improved Solar Radiation Storm characterization**
  - **Heavy ions for improved diagnosis of satellite single event upsets**
- **DSCOVER: NOAA's first operational deep space mission, at L1**
  - **Solar wind characteristics from L1: bulk solar wind density, velocity, magnetic field (enables 15 - 60 min warnings)**
  - **Presently using NASA/ESA SOHO CME images to define the inner boundary of the operational CME propagation code(WSA-Enlil) derived from science research (1-3 day warnings of Earth arrival of CMEs, including shape, density, velocity and direction)**
  - **L1 solar wind characteristics used in the Univ. of Michigan MHD magnetospheric model to determine the geoeffectiveness of the space weather storms**
- **All data delivered to Space Weather Prediction Center Real-time, 24/7**

GOES – 16 First Results: Multi-Spectral Solar Imaging

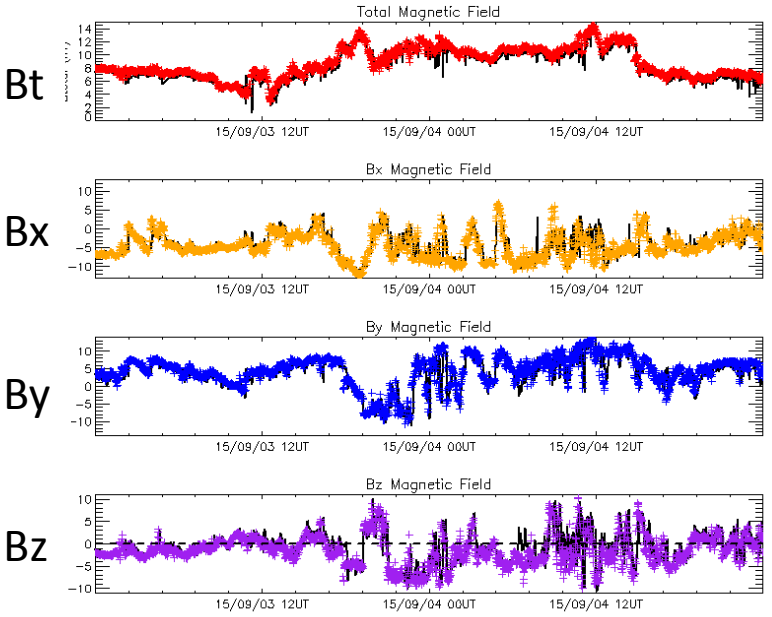


DSCOVR Magnetometer

NOAA requirements satisfied

Requirement	Value	Performance
Range	0.1-100 nT	0.004-65,500 nT
Accuracy	+/- 1 nT	+/- (0.5-0.9) nT
Cadence	1 minute	50 Hz

SWPC provides 1 second
and 1 minute averaged data



Sept 3-5, 2015

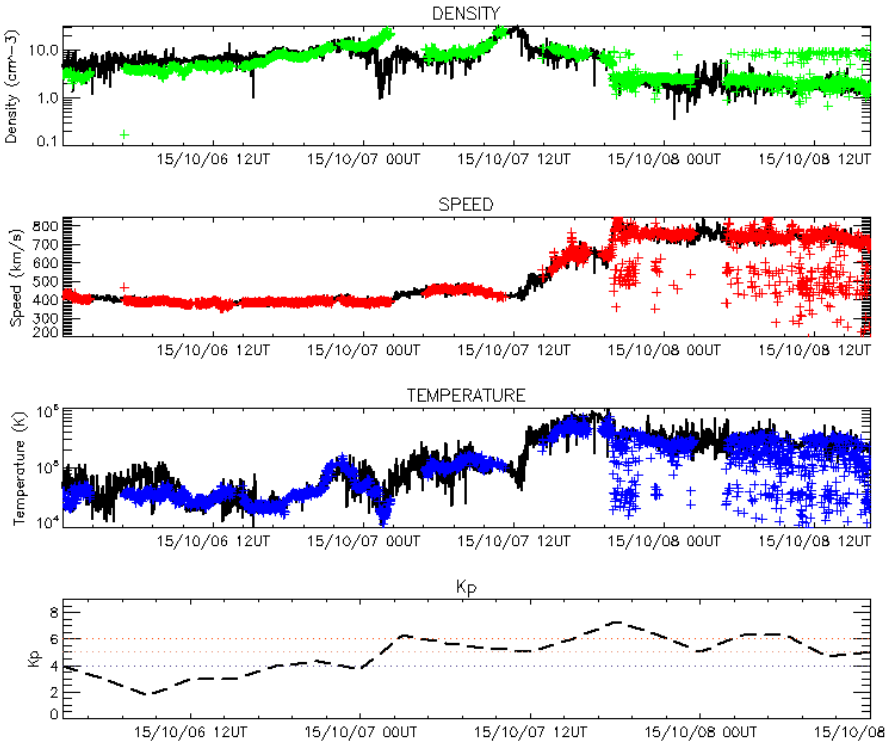
DSCOVR shown in color
ACE in black

DSCOVR Faraday Cup

Original data-processing algorithm did not meet requirements

Requirement	Required Value	Ground Performance
Velocity Range	200-1250 km/s	168-1340 km/s
Density Range	1-100 cm^{-3}	0.22-219 cm^{-3}
Temperature Range	$4x10^4$-$2x10^6$ K	$3.9x10^4$-$7.3x10^7$ K
Cadence	0.0167 Hz	2 Hz

Updated algorithms have been implemented



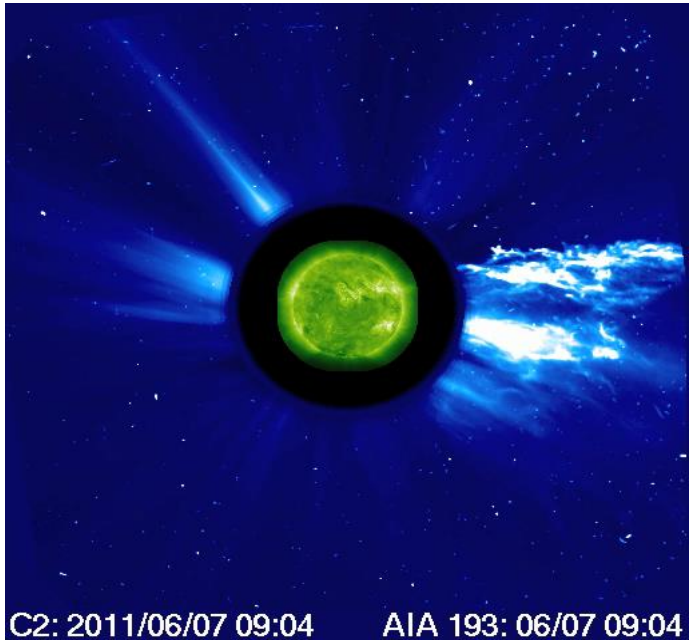
October 7-8, 2015

Future Observational Capability

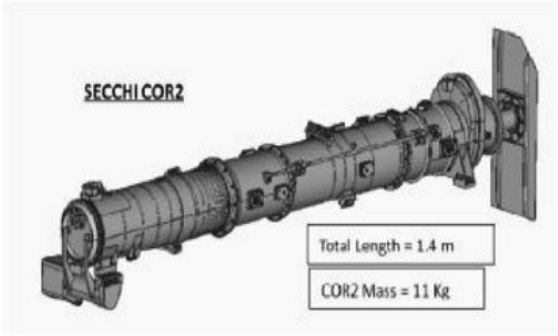
Space Weather Forward Observatory (SWFO) Mission to L1

National Space Weather Strategy Priority

Space Weather Bill **Launch target: 2022**



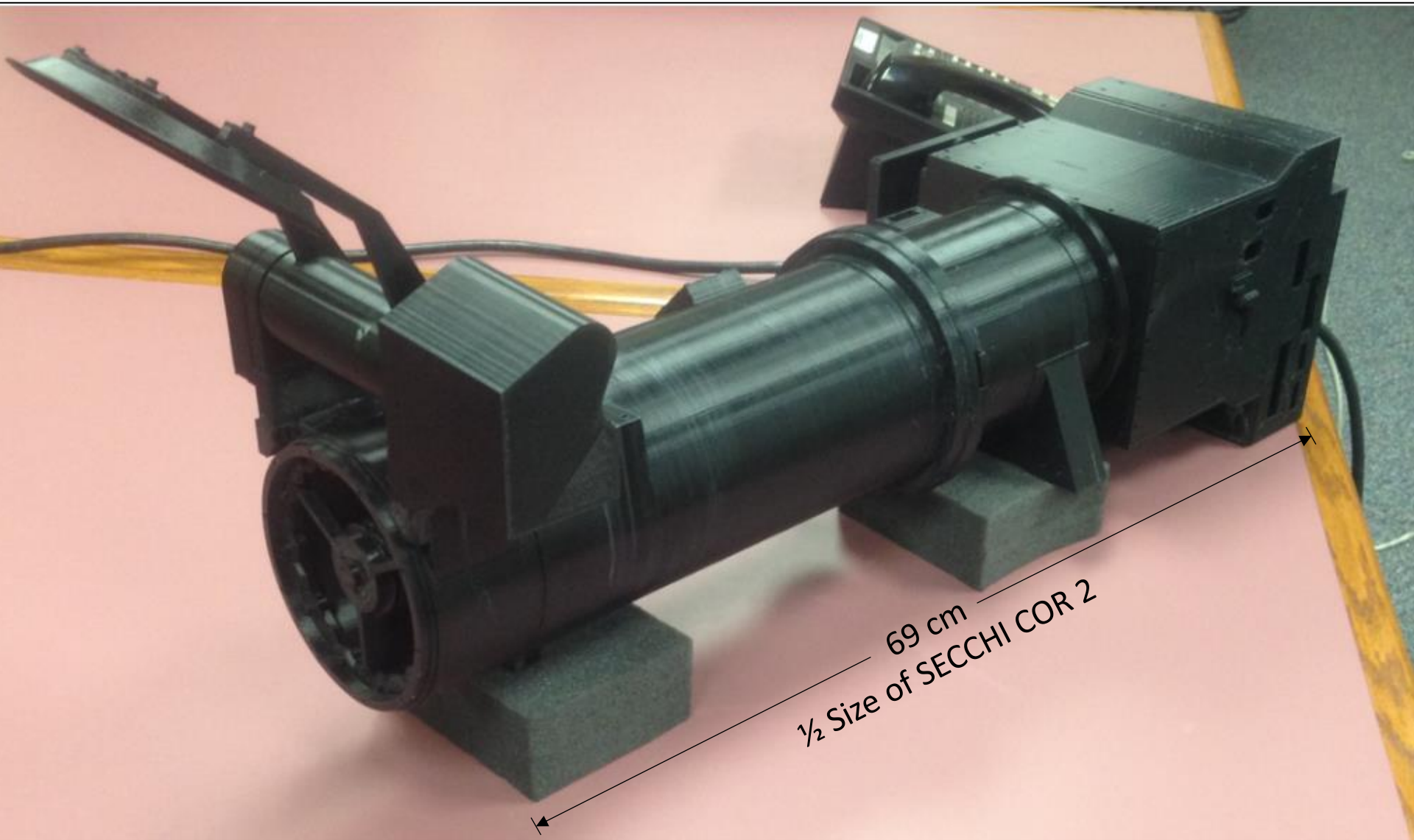
Replaces SOHO/LASCO
Launched in 1995



Compact Coronagraph
50% reduction in size

Innovative diffraction from multiple occultors produces CME image

CCOR 3D Print Model



Space Weather Forward Observatory

- **Two Satellites, Two Launch Vehicles**
  - Solar wind instruments: magnetic field, solar wind plasma density and velocity, suprathermal ions
  - Compact Coronagraph (NRL - CCOR)
  - Target first launch 2022, second launch 2027
- **Independent Study Team (IST)**
  - Independent Study Team (IST) assisted NESDIS by providing findings on concepts developed in 2014
  - 2017: NESDIS to make decision on procurement and program strategy
- **Coronagraph Gap Mitigation Technology Demonstration**
  - Concerns about SOHO lifetime and coronagraph imaging continuity
  - NOAA is investigating a tech demo coronagraph mission
  - Reviewing NRL plans for CCOR development and tech demo unit
  - NOAA RFI (Sept. 2016) for CCOR Deployment opportunities by 2019-2020
    - 16 Responses being evaluated from industry, centers, academia – generally rideshare opportunities

Backup

Take Away – Next Steps

- **Two Satellites, Two Launch Vehicles**
  - **Solar wind instruments: magnetic field, solar wind plasma density and velocity, suprathermal ions**
  - **Remote imaging: Compact Coronagraph (NRL - CCOR)**
  - **First launch 2022, second launch 2027**
- **Coronagraph Gap Mitigation Technology Demonstration**
  - **Concerns about SOHO lifetime and coronagraph continuity**
  - **NOAA investigating a gap mitigation, tech demo coronagraph mission**
  - **Reviewing NRL plans for CCOR development and possible tech demo flight options**
  - **NOAA RFI for CCOR Deployment opportunities by 2019-2020**
    - **16 Responses being evaluated from industry, centers, academia – generally rideshare opportunities**
- **Partnership of research and operations agencies provides critical synergy for both endeavors**

CENTER FOR INTEGRATED SPACE WEATHER MODELING

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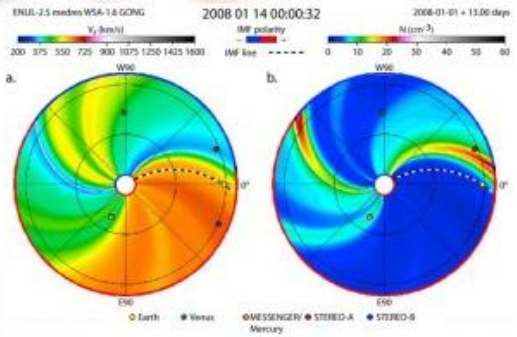

CISM MODEL AIDS INVESTIGATION OF MERCURY'S MAGNETOSPHERE

On January 14, 2008, the Mercury Surface, Space Environment, Geochemistry, and Ranging (MESSENGER) spacecraft executed the first of three flybys of Mercury as a step toward its eventual orbit insertion in 2011. During the spacecraft's closest approach to the planet, several interesting magnetospheric phenomena were observed. However, interpretation of these phenomena proved difficult in the absence of concurrent measurements of local solar wind conditions. In order to provide this needed context, CISM's WSA-ENLIL model was used to characterize the solar wind throughout the inner heliosphere. Comparisons of modeled parameters with measurements at several heliospheric locations (Earth, both STEREO spacecraft, and MESSENGER) provided an effective means of validating the model's solar wind specification, thus establishing confidence in its use for interpreting the MESSENGER data. This approach is expected to provide an important tool in future MESSENGER analyses. These results are reported by Baker et al. in the Journal of Geophysical Research [doi:10.1029/2009JA014287, 2009].

FIRST PHD IN AAMU SPACE SCIENCE CONCENTRATION

In November, 2009, Dr. Fana Mulu-Moore defended her thesis as the first Ph.D. space science graduate in the Physics Department at Alabama A&M University (AAMU). AAMU, a CISM member institution, established a graduate concentration in space science with CISM support that included